Jet Quenching in the Direction Opposite to a Tagged Photon in High-Energy Heavy-Ion Collisions *

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The study of large p_T jets can probe their energy loss due to inelastic scatterings inside dense matter or a quark-gluon plasma. Because of the enormous background in high-energy heavy-ion collisions, the conventional calorimetric study cannot measure the jet energy to the accuracy required to determine the energy loss.

In this work, we proposed thestudy of jet quenching in high-energy heavy-ion collisions by measuring the p_T distribution of charged hadrons in the opposite direction of a tagged direct photon. A direct photon is produced by quark-antiquark annihilation or quark(antiquark)-gluon Compton scatterings in which a gluon or quark(antiquark) jet is also produced in the opposite direction of the photon. By tagging a direct photon with a given transverse energy E_T^γ, one can avoid the uncertainties associated with the jet production cross section. One can also determine the initial transverse energy of the produced jet, $E_T \approx E_T^\gamma$, from momentum conservation, modulo calculable corrections from initial state radiations.

In such events, the p_T spectrum of charged hadrons from jet fragmentation in the opposite direction of the tagged photon is a very good approximation of the jet fragmentation function and is estimated to be well above the background which can be reliably subtracted at moderately large p_T. We demonstrate that comparison between the extracted fragmentation function in AA and pp collisions can be used to determine the jet energy loss and the interaction mean-free-path in the dense matter produced in high-energy heavy-ion collisions.

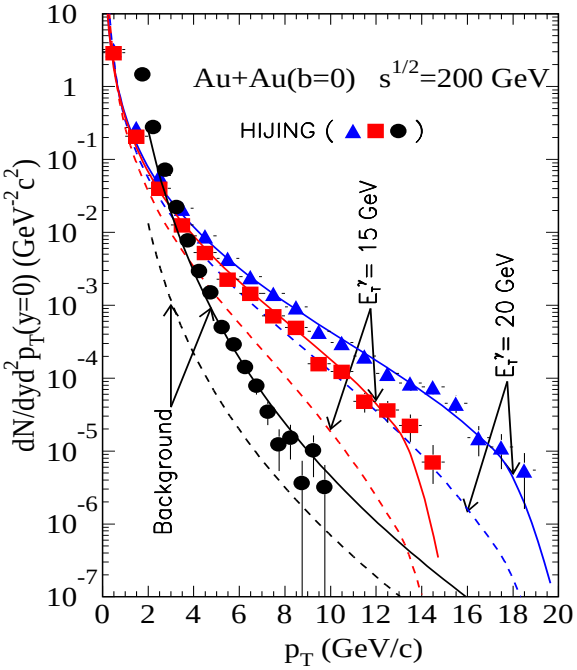

Figure 1: The differential p_T spectrum of charged particles from the fragmentation of a photon-tagged jet with E_T^γ =15, 20 GeV and the underlying background in central $Au + Au$ collisions at $\sqrt{s}$ = 200 GeV. The direct photon is restricted to $|y| \leq \Delta y/2 = 0.5$. Charged particles are limited to the same rapidity range and in the opposite direction of the photon, $|\phi - \phi_\gamma - \pi| \leq \Delta\phi/2 = 1.0$. Solid lines are perturbative calculations and points are HIJING simulations of 10K events. The dashed lines are calculations with jet energy loss, $dE_q/dx = 1$ GeV/fm and the mean-free-path $\lambda_q = 1$ fm.

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